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Understanding the Dynamics of Software Projects: An Introduction to Software Process Simulation

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ABSTRACT
Static representations of development processes provide a basis for communication and coordination of work, as well as for planning work. However, they do not provide any information about the actual behavior of a project, including the effects of staffing decisions, quality-inducing activities, delays, resource contentions, and so forth. Software process simulation (SPS) has demonstrated the capability for providing insight to the dynamics of software projects and supporting project management decisions. This tutorial is a SPS introduction that emphasizes practical approaches to modeling and simulation for both researchers and practitioners. We will discuss modeling and simulation, types of simulation, an historical overview of SPS, the disciplines that contribute to successful SPS work, modeling constructs commonly used to represent software development dynamics, and methods for conducting a SPS project.

Categories and Subject Descriptors
D.2.9 [**Software Engineering**]: Management – *software process models*; K.6 [**Management of Computing and Information Systems**]: K.6.1 Project and People Management – *systems development*, K.6.3 Software Management – *software process*.

General Terms
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OVERVIEW
Static representations of development processes provide a basis for communication and coordination of work, as well as for planning work. However, they do not provide information about the actual behavior of a project, including the effects of staffing decisions, quality-inducing activities, delays, resource contentions, and so forth. Software process simulation (SPS) has demonstrated the capability for providing insight to the dynamics of software projects and supporting project management decisions. This tutorial is a SPS introduction that emphasizes practical approaches to modeling and simulation for both researchers and practitioners.

Simulation can take many forms, so an overview of different forms of simulation provides context for dynamic modeling in SPS. Different computational methods used for simulation are compared, including spreadsheets, Bayesian networks, and dynamic modeling. Examples of each demonstrate different SPS approaches.

Software processes are many and can be modeled at many levels. Software development processes are a subset of product development processes. The dynamics of product development processes have been modeled dynamically for over 30 years and have contributed to our understanding of managing project development projects and programs.

SPS is an interdisciplinary activity, drawing upon the fields of software engineering, industrial engineering, and project management. SPS requires software process expertise, modeling and simulation skills, ability to apply statistics, and ability to engage effectively with stakeholders.

SPS is a young field that began in the 1980s. It has been an important topic for software process researchers, who have been developing constructs and building blocks now seen in many SPS models.

The success of a SPS project depends on many factors, but begins with a clear statement of the intended purpose of modeling. SPS has many purposes. A well-defined purpose limits the scope of a model, enhances its usefulness, and facilitates verification and validation.

A number of verification and validation techniques are available for building confidence in a modeling project, the model(s) produced by the project, and the results produced by exercising a model. Among these are statistical experiments that provide deeper insights to process behavior.

This tutorial includes four SPS case studies. These case studies include modeling for both industrial and research purposes.